EMO Environmental Management Operations

Limited Feasibility Study

Remedial Activities at U.S. Department of Energy's Former Geothermal Test Facility Near El Centro, California

August 1992

Prepared for
Department of Energy
San Francisco Field Office
under Contract DE-AC06-76RLO 1830

Environmental Management Operations
Operated for the U.S. Department of Energy
by Battelle Memorial Institute

Battelle

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for Environmental Management Operations
under a Related Services Agreement
with the U.S. Department of Energy

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Table of Contents

Table of Contents (Continued)

LIST OF TABLES

Table of Contents (continued)

LIST OF FIGURES

Table of Contents (continued)

LIST OF FIGURES

EXECUTIVE SUMMARY

The U.S. Department of Energy's former Geothermal Test Facility near El Centro, California (herein referred to as the "site") was the subject of (1) a field investigation to characterize brine residues contained within a former geothermal production fluid holding pond and (2) a limited feasibility study to develop and evaluate remedial alternatives for closure of the pond.

This report was prepared by Bechtel Environmental, Inc. (Bechtel) for Battelle Environmental Management Operations (EMO) under Master Agreement 071912-A-D6, Task Order 142126. The Task Order Scope includes planning, organization, and execution of activities necessary to assess and remediate, as required, the former geothermal brine holding pond. The Task Order Scope does not include examination, characterization, or evaluation of alternatives which may be required for two small evaporation ponds adjacent to the main brine pond.

The former brine holding pond is roughly square and covers an area slightly greater than 6 acres. An 8 foot high soil berm surrounds the pond which varies between 6 and 9 feet deep. A 4- to 8-inch layer of brine sludge remains in the pond. The brine layer is underlain by a 6- to 9-inch protective sand layer over a 10-mil PVC liner. No free-standing water is present in the pond. The brine residues are moist with the consistency of a plastic clay below the first 2 to 4 inches, which are typically dry and brittle.

The U.S. Bureau of Reclamation initiated studies of the geothermal resources at the East Mesa Site in 1968 as a potential method of augmenting the Lower Colorado River water supply. Operation of experimental desalting plants at the site began in 1972. The DOE became the exclusive operator of the site in October 1978. The PVC-lined brine holding pond was installed in 1972 to temporarily store and evaporate brine blowdown water as well as untreated brines extracted in the geothermal exploration process.

During site operations from 1972 to 1975, the waste brine was discharged into the holding pond. The disposal capacity of the pond was inadequate to handle increased site activities; consequently a waste brine injection system

was installed in 1976. The holding pond was used intermittently after installation of the injection system, both to supplement the injection system, and to provide for brine disposal when the injection system was inoperational. Geothermal research activities at the site were eventually discontinued in the late 1970's and early 1980's as commercial-scale geothermal power development matured in the region.

The local Regional Water Quality Control Board (RWQCB) issued a Waste Discharge Requirements Order (California RWQCB, 1989) for the geothermal test facility that includes the pond. This order requires cleanup and disposal of the waste from the pond to a site approved by the local RWQCB.

The contaminants of concern within the dried brine residues are concentrations of water soluble salts, primarily sodium chloride. The pond residues are not a hazardous waste under the Resource Conservation and Recovery Act (RCRA). Residue samples taken during the field investigation did not exhibit any characteristics of hazardous wastes (i.e., ignitability, corrosivity, toxicity, reactivity). Further, wastes that are listed under 40 CFR Part 261 as hazardous waste are not present at the site. Accordingly, the requirements under RCRA Subtitle C (and the implementing regulations at 40 CFR Part 260 *et seq.*, including land disposal restrictions) are not applicable. The residues also did not exhibit characteristics of hazardous waste under California regulations.

Prior to the issuance of this Limited Feasibility Study (LFS) report, the Colorado River Regional Water Quality Control Board had indicated that they would classify the brine waste as designated, non-hazardous waste. The RWQCB will issue a final classification of the brine residues after review of this LFS.

Based upon the hydrogeologic information presented in this report (see Sections 1.2.4 and 1.2.5), water quality in the underlying aquifer is of poor quality because of upward recharge from both the deep geothermal aquifer and the intermediate geothermal aquifer. Water balance calculations performed using an EPA (1975) method predict that, under existing conditions (i.e., in the absence of any remedial action), leachate generation

would be negligible and any produced would not migrate to the underlying aquifer (see Tables 4-2, 4-3, and 4-4).

The purpose of this LFS was to develop and evaluate a range of distinct management alternatives which can prevent or control waste migration. To meet this goal, a number of technologies and unit process options were evaluated and screened prior to the development of complete alternatives.

One process option which appeared to represent a possible remedial alternative was excavation of brine residues followed by injection of the soluble fraction of the brines into the deep geothermal aquifer . This option was evaluated (see Section 2.5.9) in detail based upon engineering considerations and the experience gained at a similar injection project (Salton Sea Scientific Drilling Project). Although it is technically possible to resolubilize a fraction of the brine residues, excessive cost and time for both the mixing/separation and injection operations make this an unattractive remediation process. Extensive treatability testing would be required due to the uncertainties associated with both the mixing/separation and injection processes. Based on the difficulties experienced at the Salton Sea Project, the negligible decrease in contaminant volume, and other limitations with respect to the significant handling, treatment, and injection costs; injection did not appear to represent an effective remedial alternative. Therefore, the injection process option was removed from further consideration in Section 3 as part of the detailed development of alternatives.

Technologies which survived the initial screening were used to assemble four remedial action alternatives for the former pond:

- Alternative 1 - No action.
- Alternative 2 - Capping of residues in-place using berm fill.
- Alternative 3 - Onsite Containment.

  Alternative 3A - Placement of the excavated brine residues in an unlined but capped waste management unit constructed onsite.

Alternative 3B - Placement of the excavated brine residues in a lined and capped waste management unit constructed onsite.

- Alternative 4 - Alternative 4 - Excavation and removal offsite of the residues with disposal in a Class II facility.

A brief summary of each alternative is presented in the following paragraphs.

Alternative 1, no action, would result in no changes in current practices at the site. There are no remedial action costs associated with the selection of this alternative.

Alternative 2 - Capping of residues in-place using berm fill. This alternative employs soil capping as a physical containment technology. The primary benefit of this alternative is the establishment of a physical barrier against human contact with the waste and natural weathering and erosion of the waste. A secondary benefit of this alternative is a significant reduction in the volume of precipitation that may contact the brine waste. Some precipitation would be stored in the soil cover placed over the waste.

Major actions taken as part of this remedial alternative would include excavating 12,000 cubic yards (cy) of berm fill to place as soil cover, installing a boundary perimeter fence, and installing four monitoring wells. Placing the berm fill as cover over the waste would restore the final grade of the pond to near the present site grade. The fence would prevent unrestricted access to the pond area. Water balance calculations have indicated that the generation of leachate is highly unlikely, however; monitoring wells may be used to track the quality of the underlying aquifer. The total present worth of this alternative, including a 30-year period of operation, maintenance for the cap, and groundwater sampling, is approximately $860,000. Monitoring would continue for the life of the closure. The actual frequency of monitoring would be established through consultation with the RWQCB.

Alternative 3A - Placement of the excavated residues in an unlined waste management unit with a landfill cover constructed onsite. This alternative (similar to Alternative 2) employs soil capping with the intent of establishing a physical barrier to prevent human contact with the waste, prevent wind

erosion of the waste, and reduce the volume of precipitation that may contact the waste. The cap would consist of a soil cover underlain by a synthetic drain layer placed over a synthetic, impermeable geomembrane liner. The soil cover, under typical conditions, would retain almost all precipitation (as discussed under Alternative 2). Precipitation in excess of soil storage capacity would move down through the cap, be captured by the drainage layer overlying the geomembrane liner, and drained away from the unit.

Actions to implement this alternative would include excavation and placement of 9,000 cy of waste into the northern side of the pond, excavation and placement of 4,000 cy of berm fill over the waste and of 8,000 cy of berm fill over the remainder of the pond area, installation of the synthetic drainage layer and geomembrane, and installation of a boundary perimeter fence. Over most of the pond area, the final grade of the capped area would be near the present site grade. In the capped area, the slope would vary from 3 to 10 percent. The total present worth of this alternative, including a 30 year period of operation and maintenance for the cap and groundwater sampling, is approximately $1.36 million. The actual frequency of monitoring for the life of the closure would be established through consultation with the RWQCB.

Alternative 3B - Placement of the brine residues into a lined and capped waste management unit. Implementation of Alternative 3B would include construction of the landfill cover described for Alternative 3A with the addition of a liner system placed at the bottom of the landfill to completely isolate the brine residues from the environment. The liner system would consist of a leachate collection system, a primary synthetic liner, a leak detection system (groundwater monitoring wells), and a secondary composite liner of clay and synthetic material. The total present worth of this alternative is approximately $2.66 million. As noted for Alternatives 2 and 3A, the actual frequency of monitoring for the life of the closure would be established through consultation with the RWQCB.

Alternative 4 - Excavation and removal of residues with disposal in an offsite Class II facility. This alternative involves excavation and removal from the site of all the brine residues and material within the former pond. Berm fill

would be placed within the excavation and amended with imported fill to restore the pond to near the present site grade. Excavated material would be transported to an offsite Class II landfill. The total present worth of this alternative is approximately $1.93 million.

The four alternatives were evaluated for their abilities to prevent or control waste migration. The pond is not a Federal or State Superfund site and therefore it is not subject to the requirements under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or RCRA. However, some evaluation criteria presented as guidelines for these regulations were used for this LFS because the methods are well defined and helpful in comparative analyses of alternatives conducted during feasibility studies for any site. The evaluation in this LFS was based on protection of human health and the environment; compliance with applicable federal and state regulations; short- and long-term effectiveness; reduction of toxicity, mobility, or volume; implementability; and cost.

The comparative analysis of alternatives indicated that the No-Action alternative did not meet the overall protection of human health and environment threshold criteria, and would probably not be acceptable. No-Action leaves the possibility of human contact and disturbance, whereas, capping the brine wastes on site (Alternatives 2, 3A and 3B) and disposing of the wastes off site (Alternative 4) significantly reduce the potential for exposure.

Implementation of Alternatives 1 and 2 would require revision of the existing Waste Discharge Requirements order for the pond (which may require a lengthy negotiation period), whereas Alternatives 3A, 3B, and 4 comply with the Waste Discharge Requirements order and exceed regulatory requirements for discharging nonhazardous (Alternatives 3A and 4) and designated (Alternatives 3B and 4) wastes to land.

In the short term required to implement any of these alternatives (one to three months) possible construction impacts (e.g., dust generation and accidents) on the site would be a concern, however, these could be easily minimized. Alternative 4 would require off-site transport (about 700 truck trailer trips), thereby increasing the potential for vehicular accidents.

The long term effectiveness of Alternatives 2, 3A, 3B, and 4 would be essentially similar since disposal in all cases would involve capping the waste, thus eliminating potential use of the pond as an unauthorized dumping area and minimizing most direct human contact.

All alternatives are relatively easy to implement. Alternatives 2 and 4 could be performed using local contractors. Alternatives 3A and 3B would also require use of a specialty contractor for liner installation, but these contractors are commonly available. To implement Alternatives 1 and 2 would require revision of the existing Waste Discharge Requirements order and approval of the local agency and community for leaving the waste in place without strict compliance with the requirements of Chapter 15, Title 23 of the California Code of Regulations.

Remediation costs for the alternatives increase from $0 for No-Action, to $860,000 for Alternative 2, to $2.66 million dollars for Alternative 3B for leaving the brine wastes in the pond, to $1.93 million dollars for off-site disposal (Alternative 4).

Alternative 4 appears to represent the most effective, long-term and easily implementable alternative based on the apparent preference of the local RWQCB and surrounding geothermal operators for off site disposal, the requirements of the existing Waste Discharge Requirements order, the current classification of the brine residues as designated wastes, and the pending interpretation by the local RWQCB of state regulations.

However, Alternative 2 may be accepted by the regulatory agencies to be in compliance with the intent of regulations for protecting the existing water quality of the state. Furthermore, Alternative 2 is about half the cost of Alternative 4. Therefore, it may represent an additional option.

Based upon the criteria listed above, Alternative 4 was recommended for implementation because it would offer the greatest degree of compliance with each of the criteria. The selection of a qualified, permitted off-site disposal facility would be important to avoid potential responsible party liabilities in the future.